

# **Validation of TES tropospheric Ozone profiles with DIAL LIDAR observations from INTEx-B Houston.**

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## Comparison with TES

- In order to compare profiles obtained from a remote sensing instrument such as TES with model or *in-situ* data, we must first take into account the limited vertical resolution and the affects of *a priori* information inherent in the retrieved profiles
- Averaging kernels intrinsically account for both, and may be used to transform model/*in-situ* profiles into “TES space” so that they may be directly compared

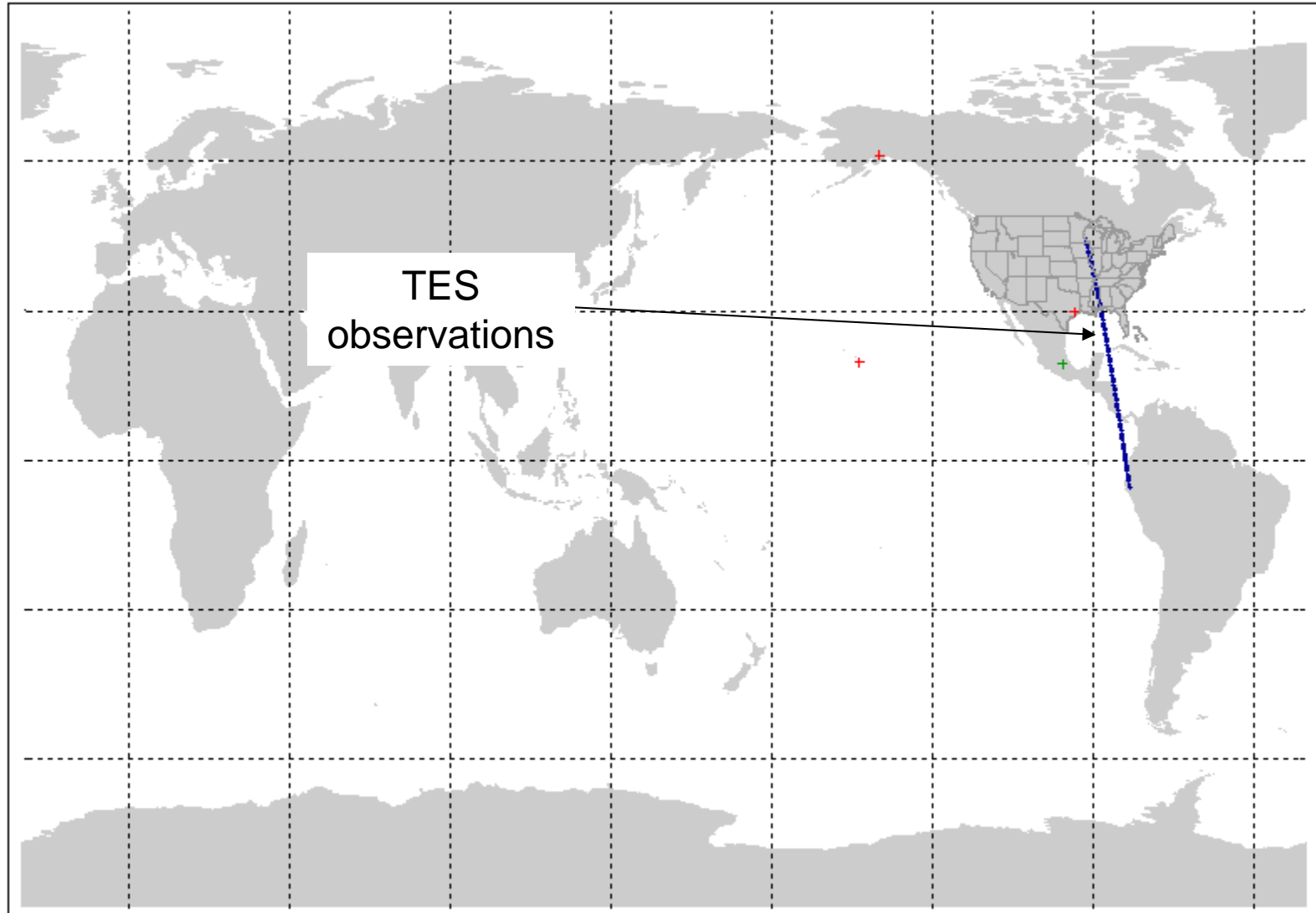
$$\mathbf{x}_{\text{final}} \equiv \mathbf{x}_a + \mathbf{A}(\mathbf{x}_{\text{DIAL}} - \mathbf{x}_a)$$

DIAL profile  
Averaging kernel  
*a priori* profile

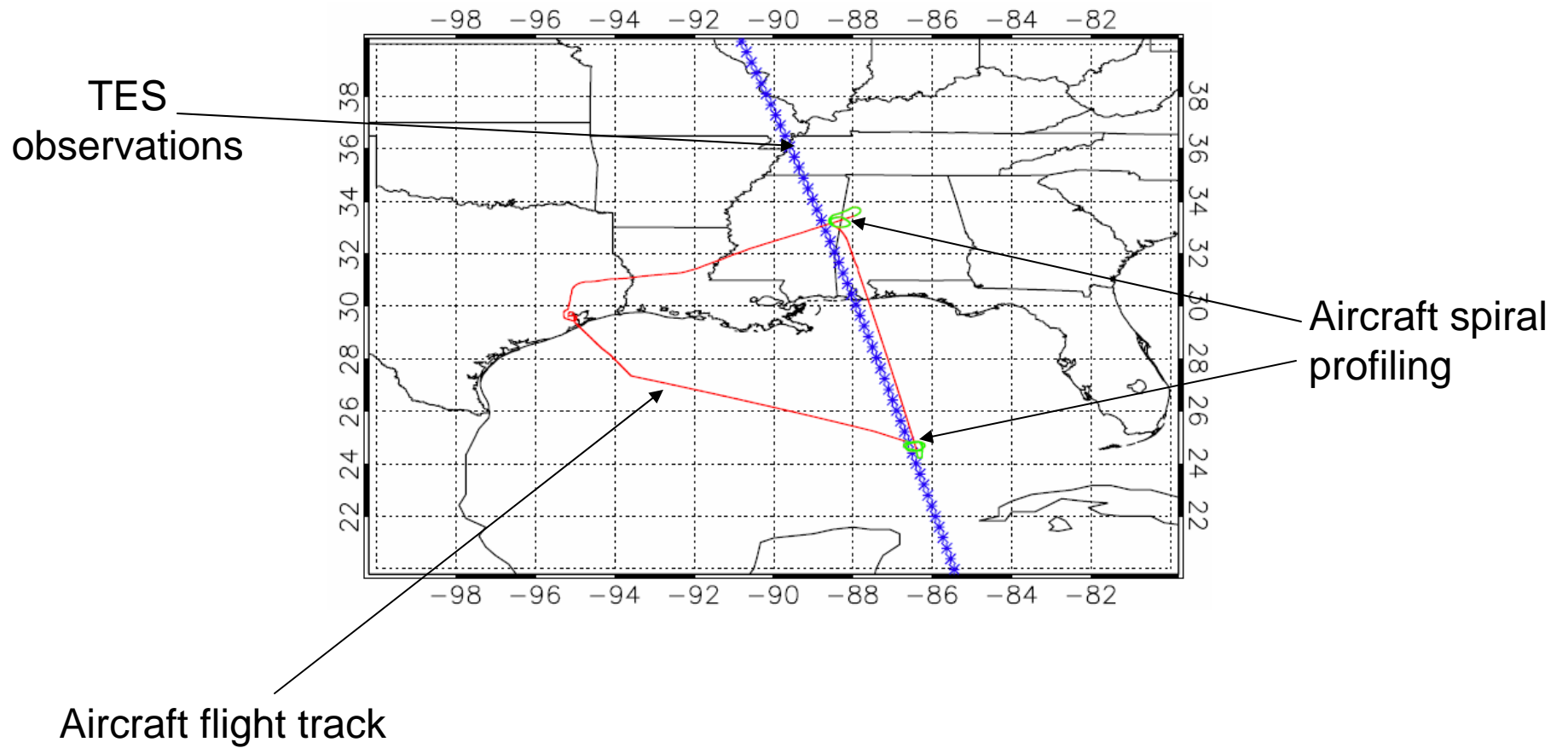
- All DIAL observations within 0.15 degrees lat/lon of each TES observation were selected and averaged for comparison with the corresponding TES profile.
- DIAL profiles were interpolated to the TES pressure grid.
- In order to apply TES averaging kernels to the DIAL profiles missing data in the DIAL profile were replaced with TES *a priori* information, each profile was also extended to the highest TES pressure level using the *a priori*.

## TES Step & Stare on March 4<sup>th</sup> 2006 (Run 3399)

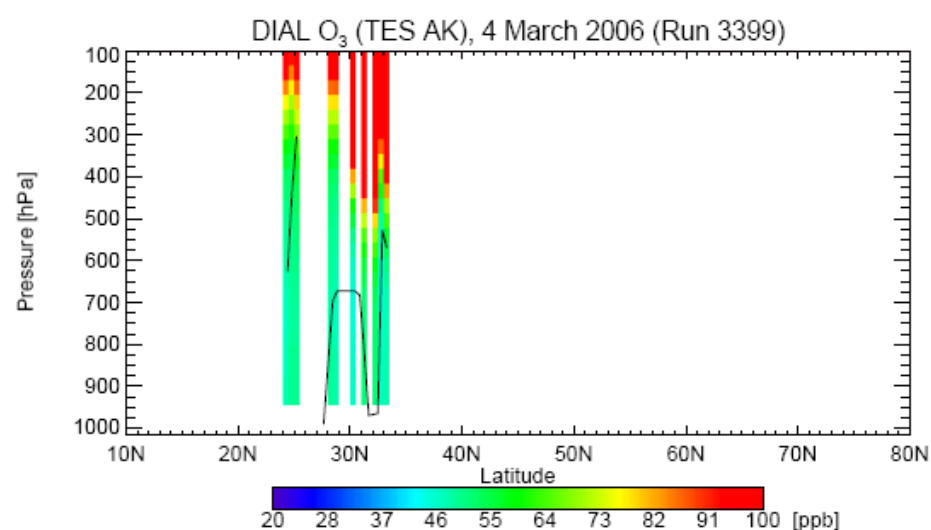
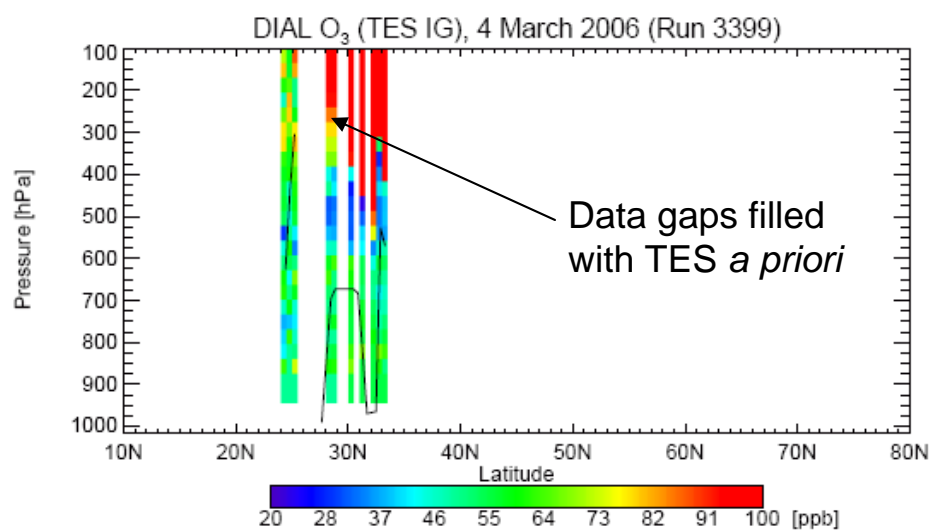
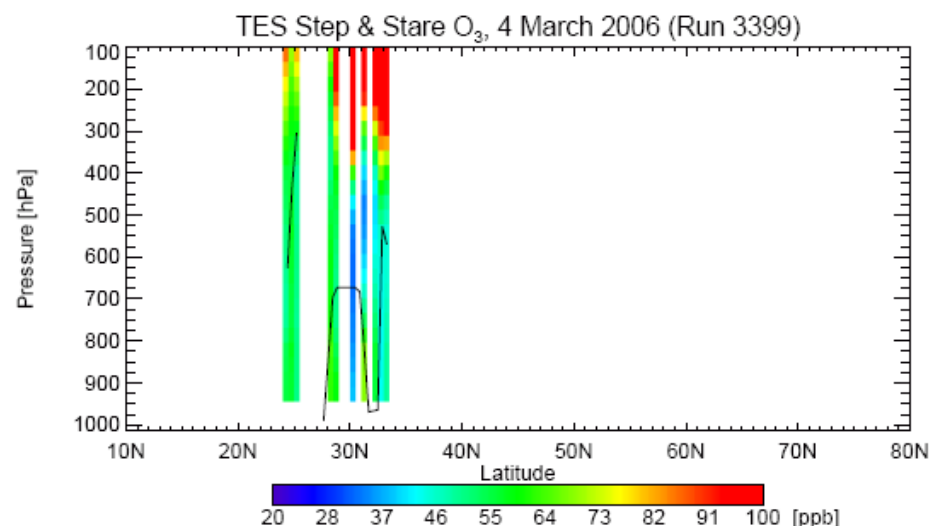
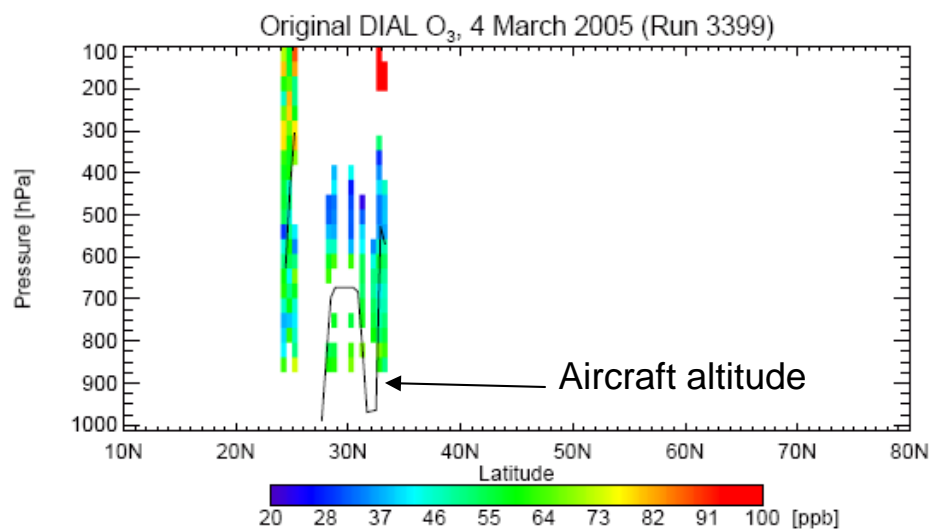
TES Step & Stare Observations: RunID=3399, Seq=1-1, Scan=0-124, UTCtime=2006-3-4 19:03:56-19:06:50



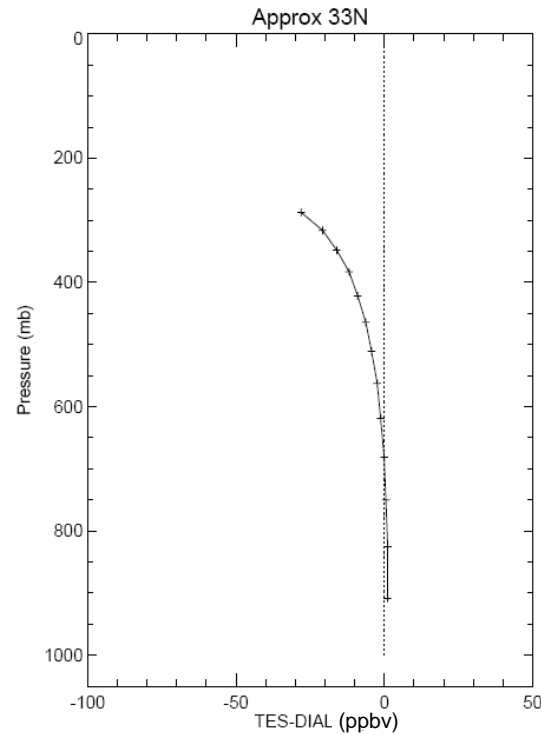
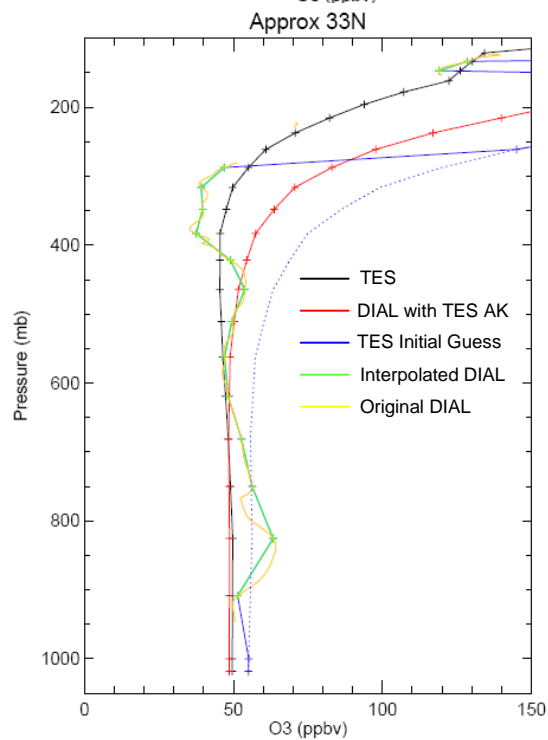
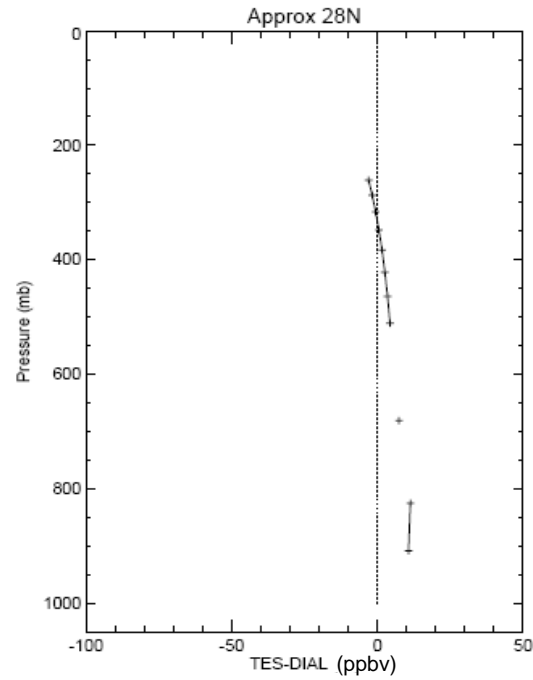
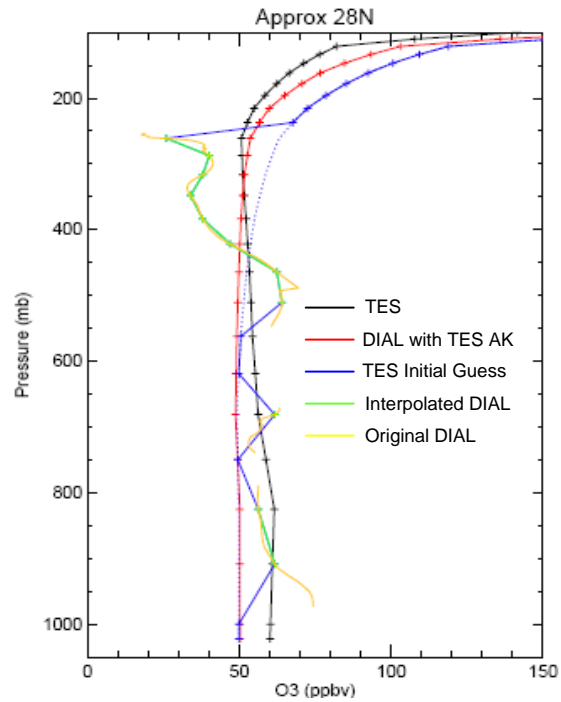
March 4<sup>th</sup> 2006 Run 3399



## March 4<sup>th</sup> 2006 Run 3399



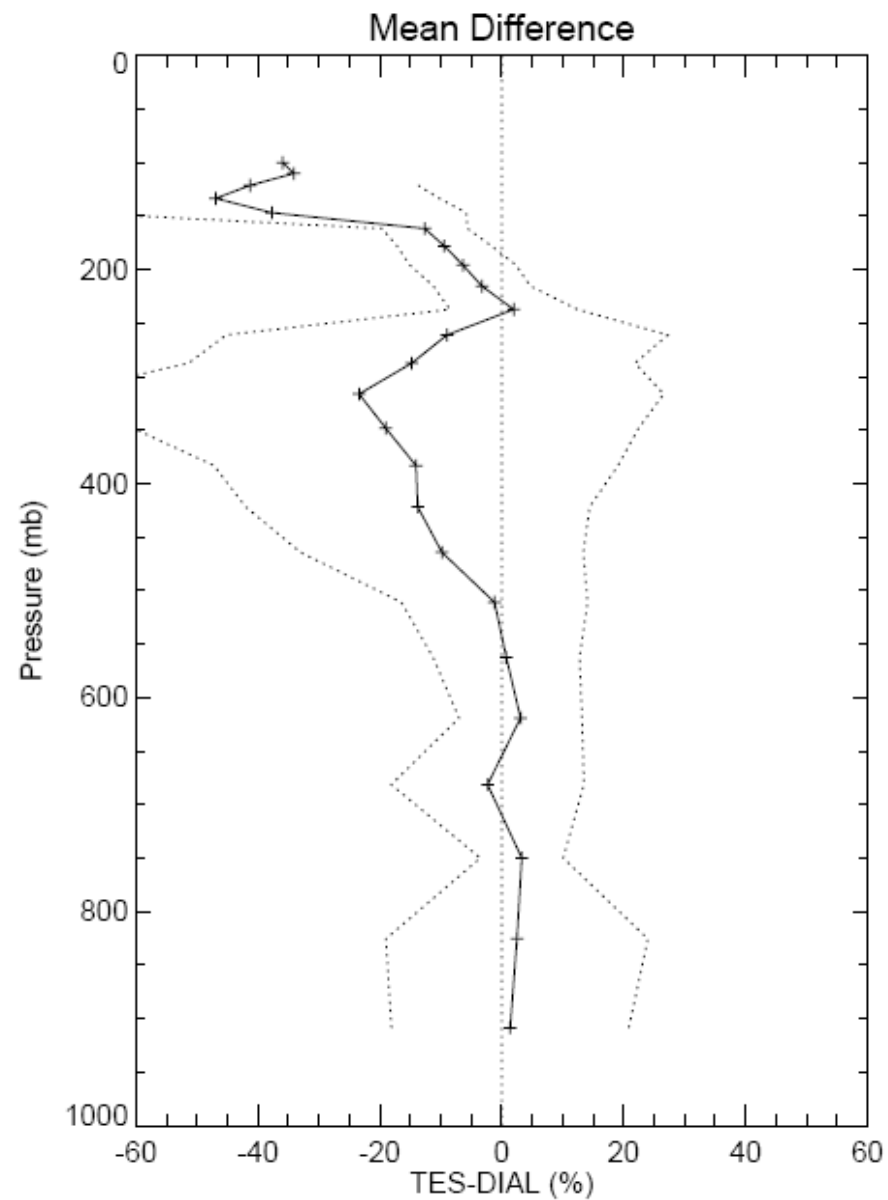
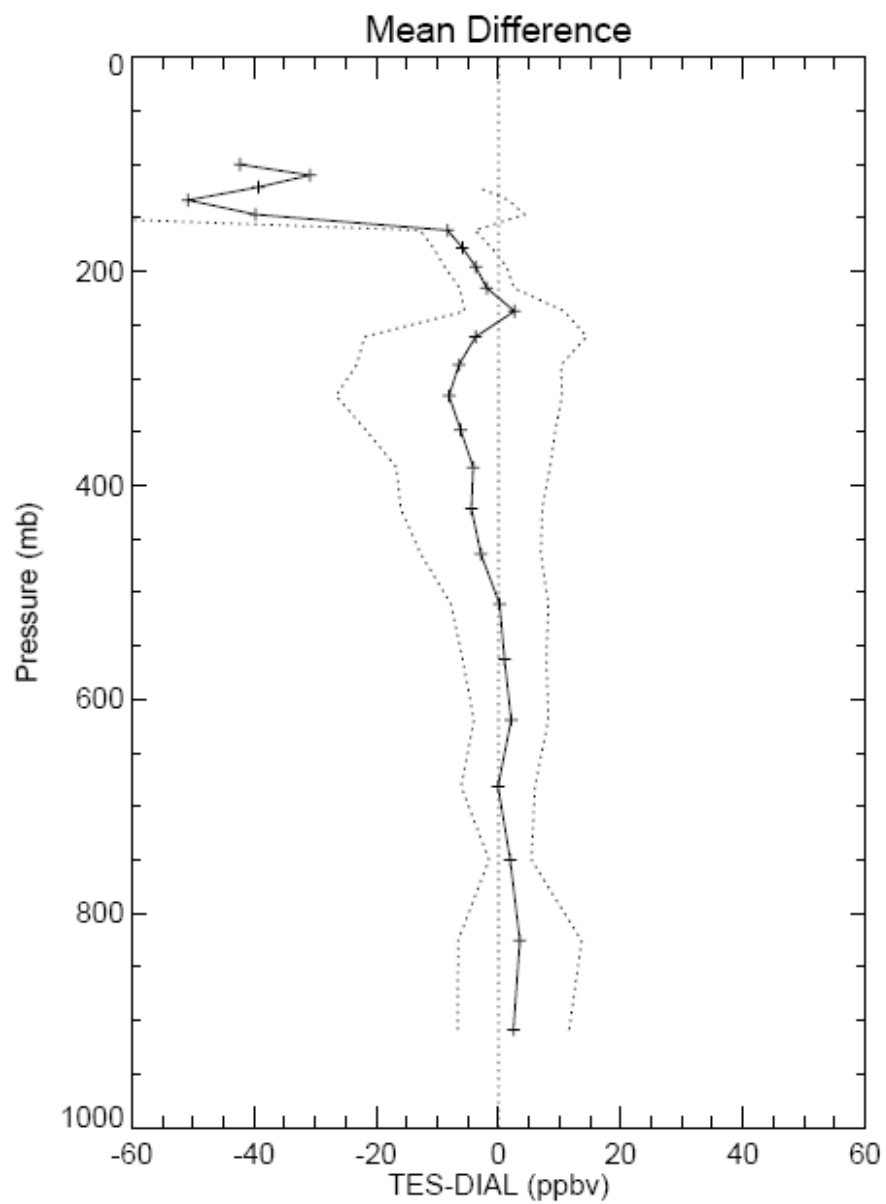
March 4<sup>th</sup> 2006 Run 3399



## Example Profile Comparisons

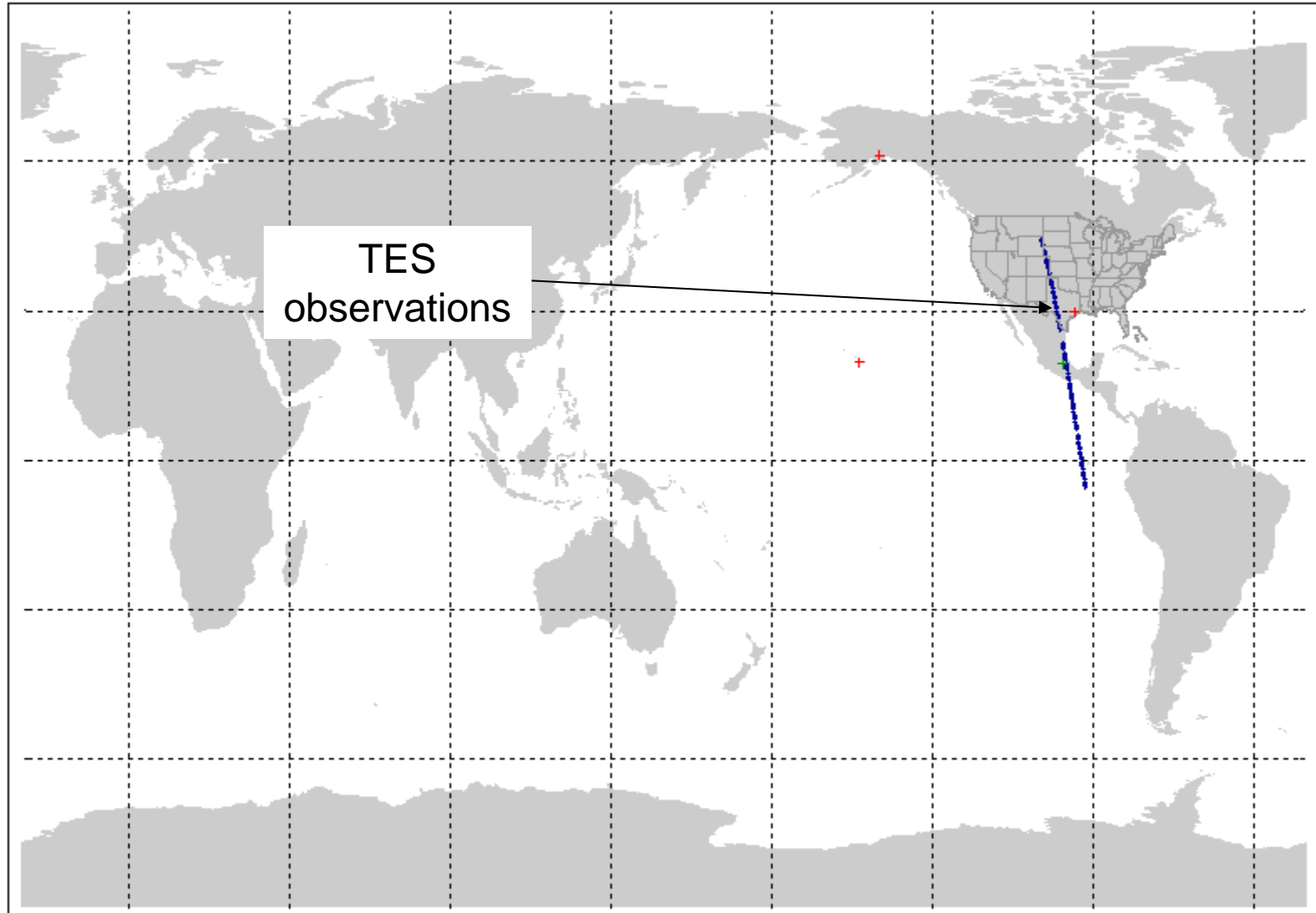
March 4<sup>th</sup> 2006 Run 3399

# TES – DIAL mean differences and standard deviation



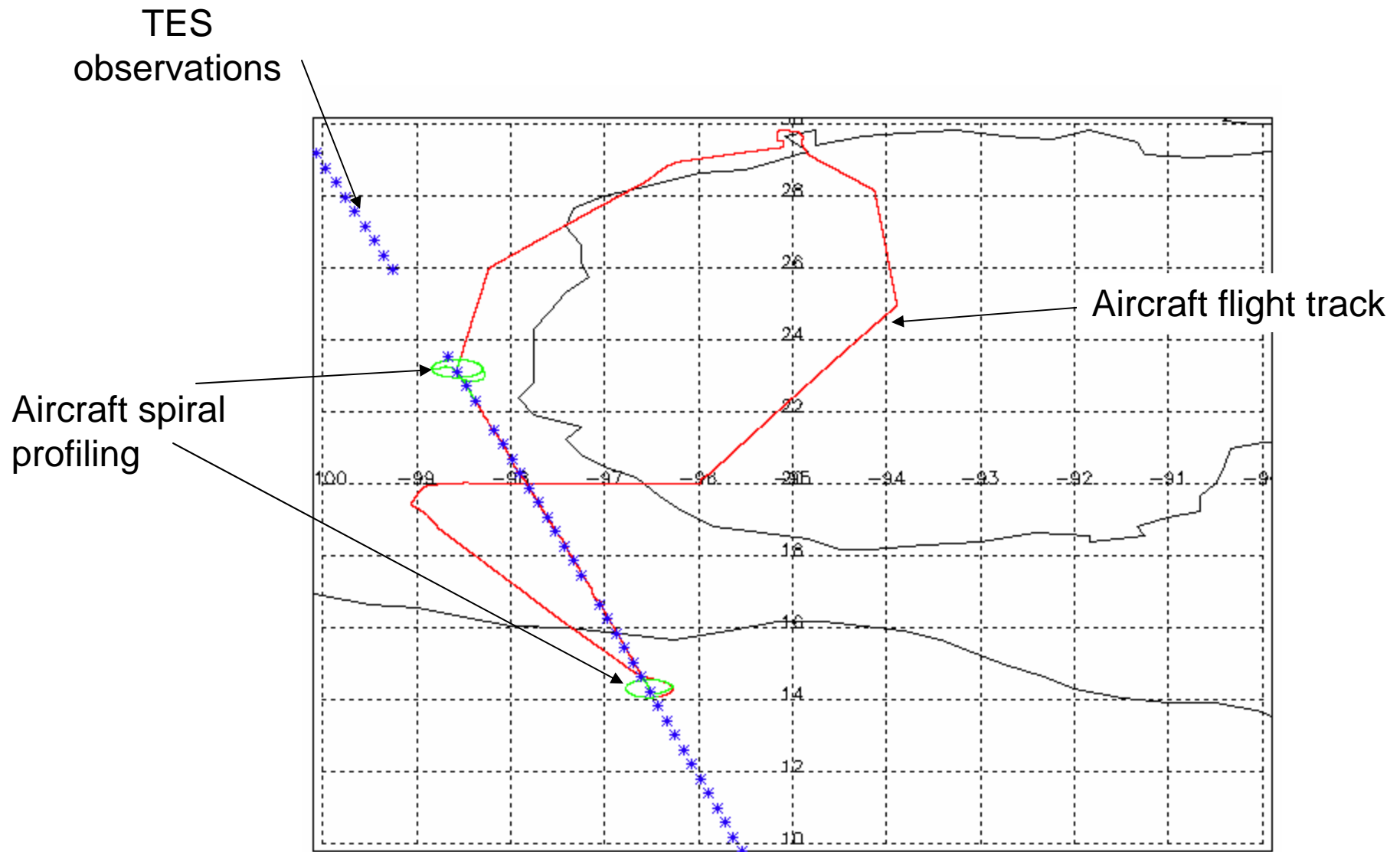
## TES Step & Stare on March 12<sup>th</sup> 2006 (Run 3440)

TES Step & Stare Observations: RunID=3440, Seq=1-1, Scan=0-124, UTCtime=2006-3-12 19:53:28-19:56:23

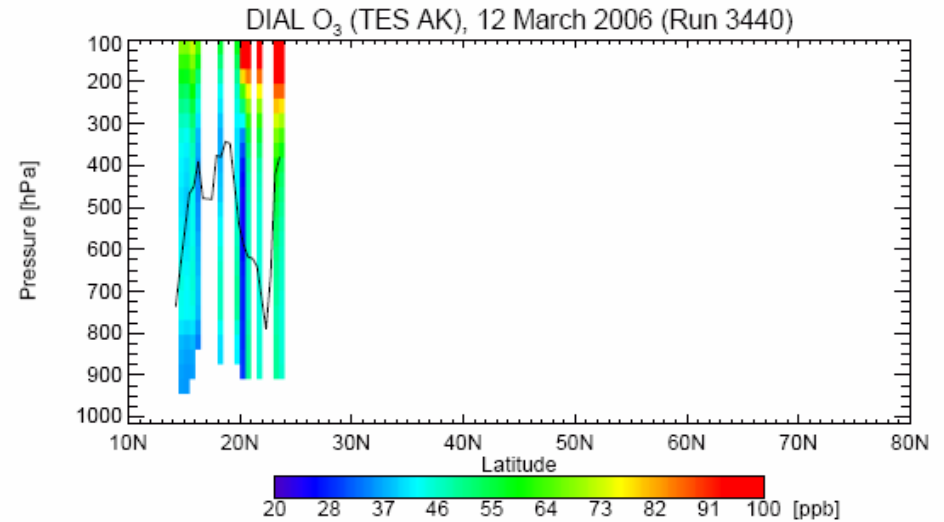
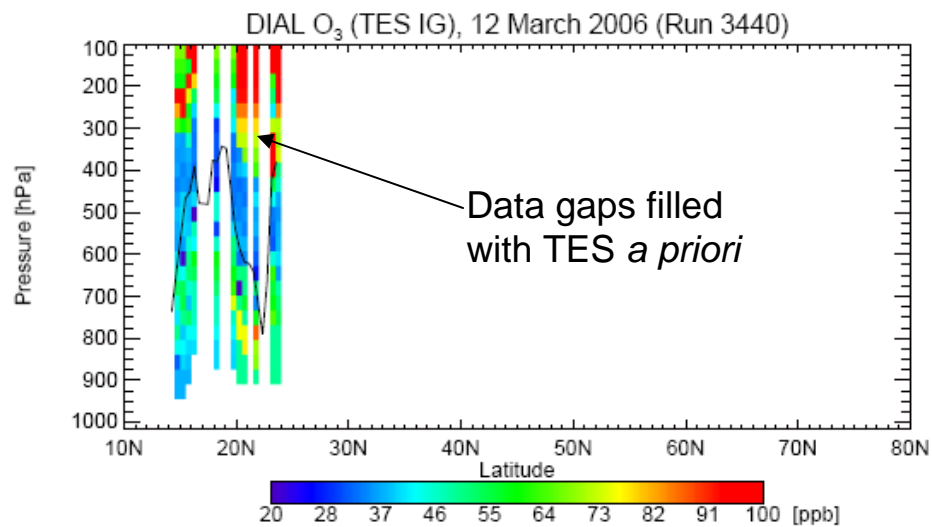
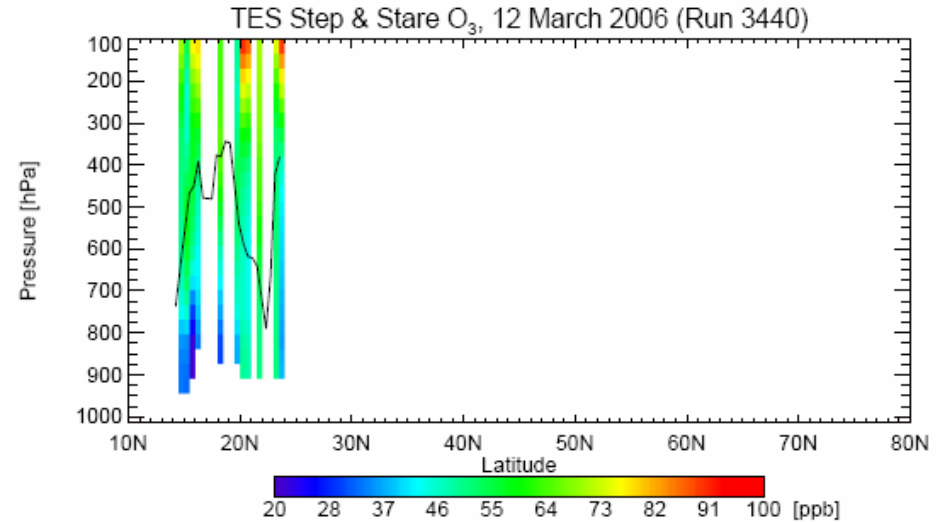
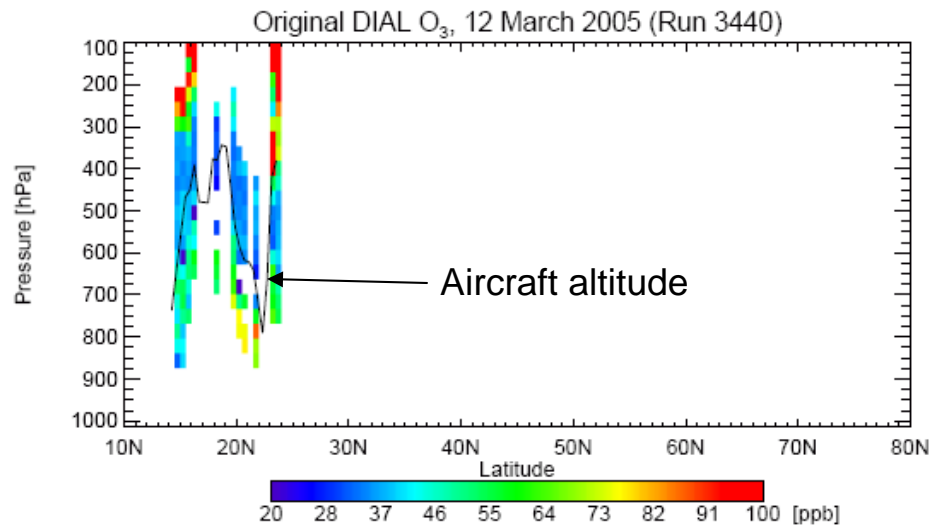




March 12<sup>th</sup> 2006 Run 3440

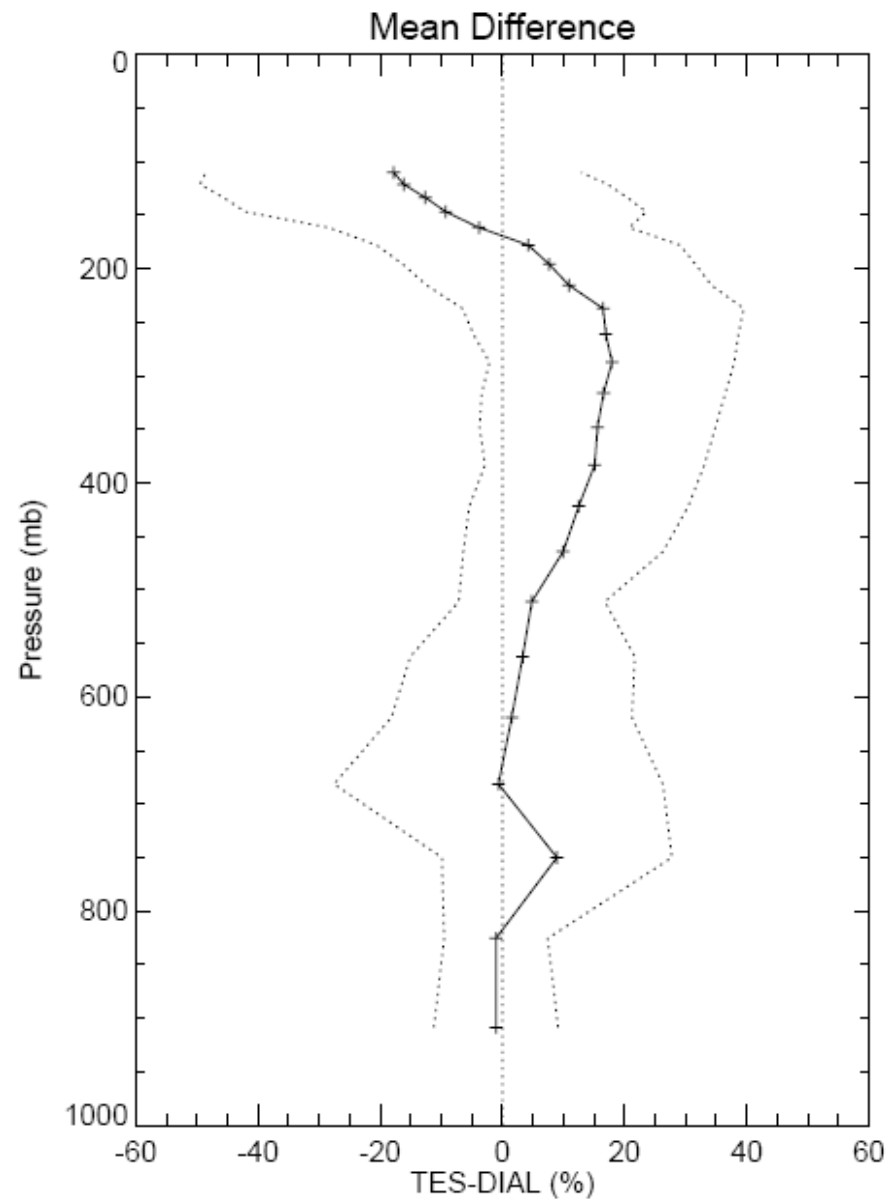
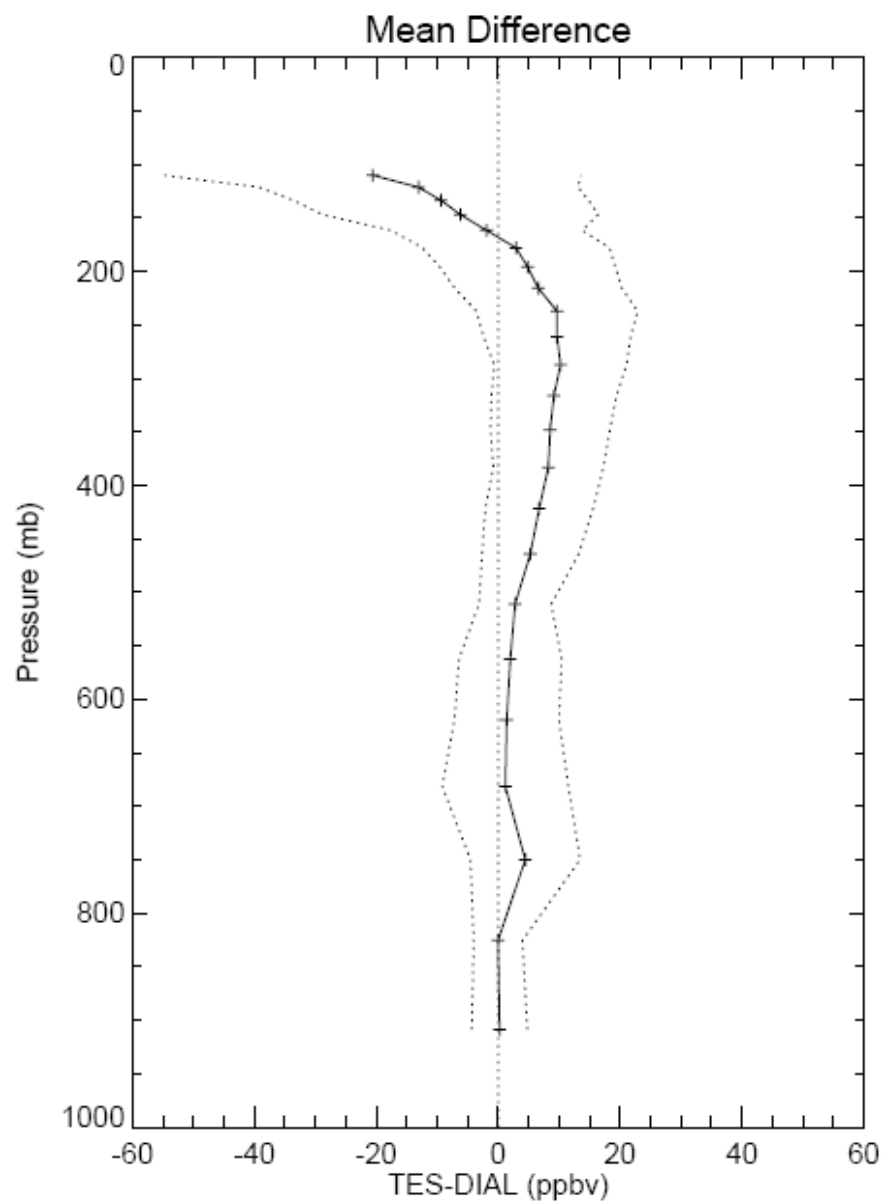


## March 12<sup>th</sup> 2006 Run 3440



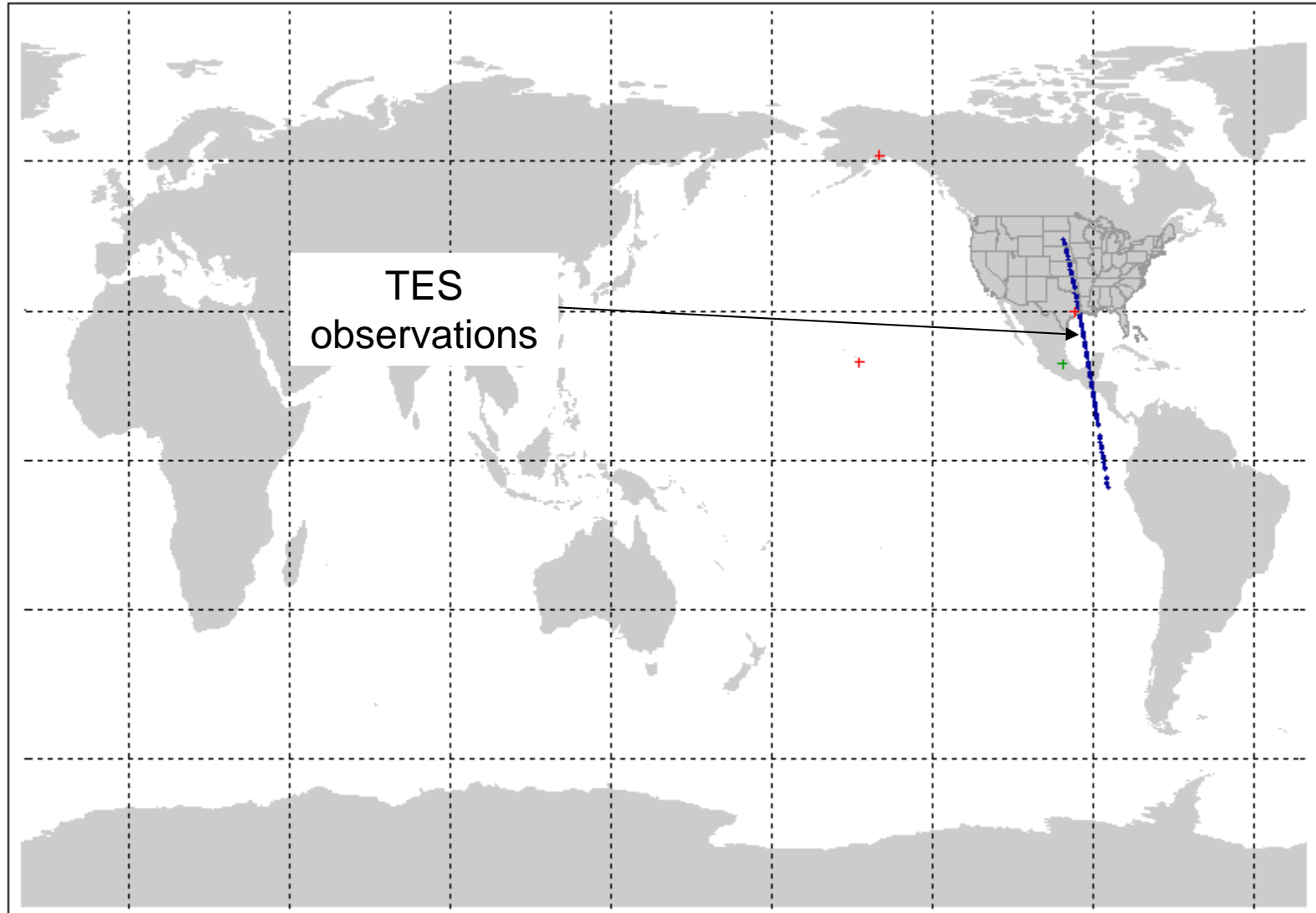
March 12<sup>th</sup> 2006 Run 3440

# TES – DIAL mean differences and standard deviation

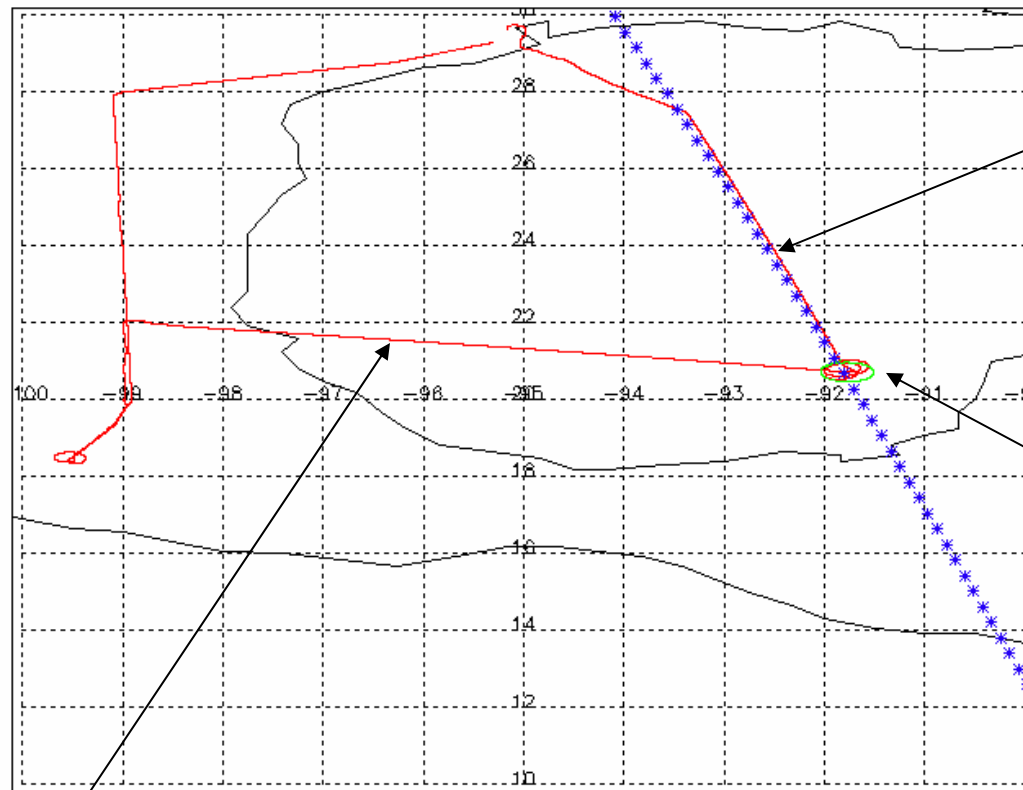


# TES Step & Stare on March 16<sup>th</sup> 2006 (Run 3459)

TES Step & Stare Observations: RunID=3459, Seq=1-1, Scan=0-124, UTCtime=2006-3-16 19:28:47-19:32:28



March 16<sup>th</sup> 2006 Run 3459

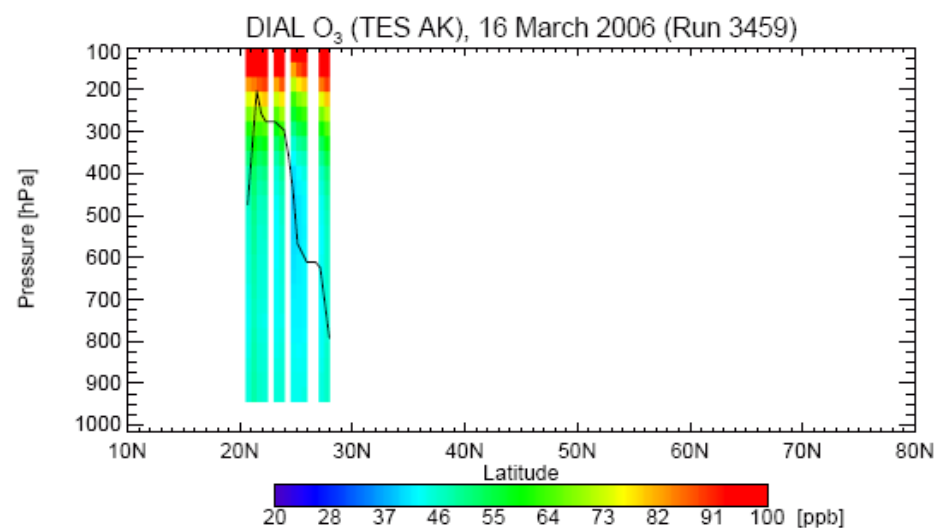
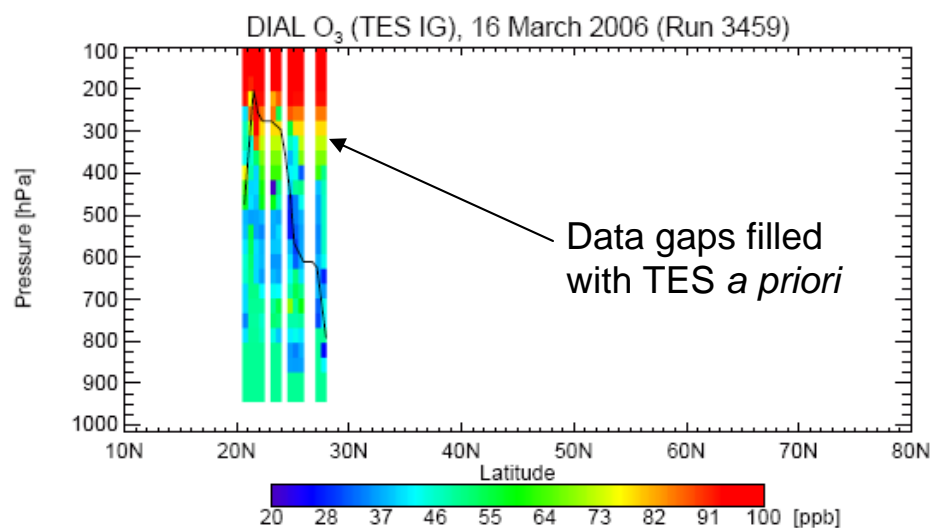
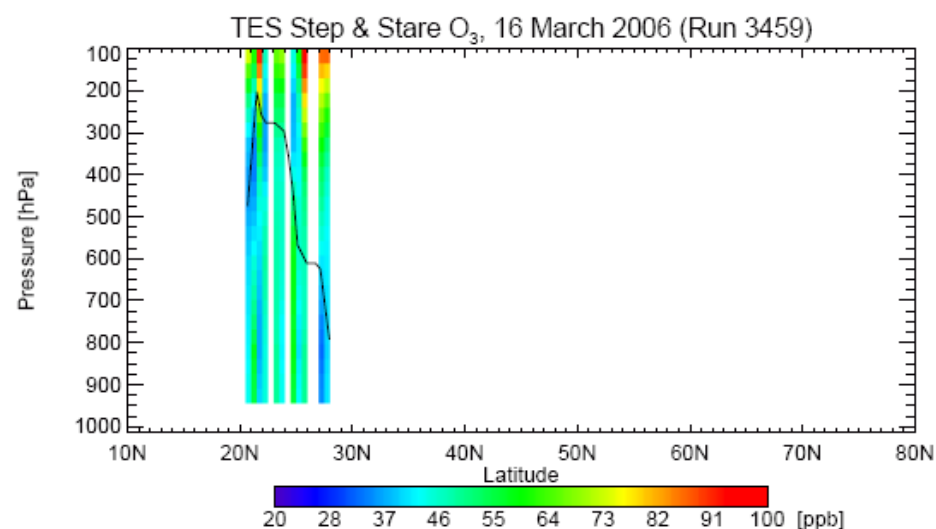
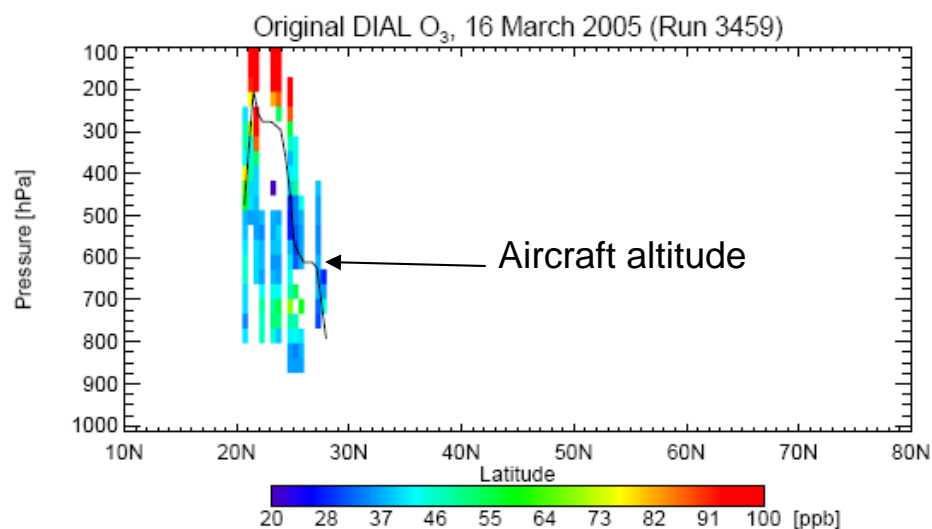


TES  
observations

Aircraft spiral  
profiling

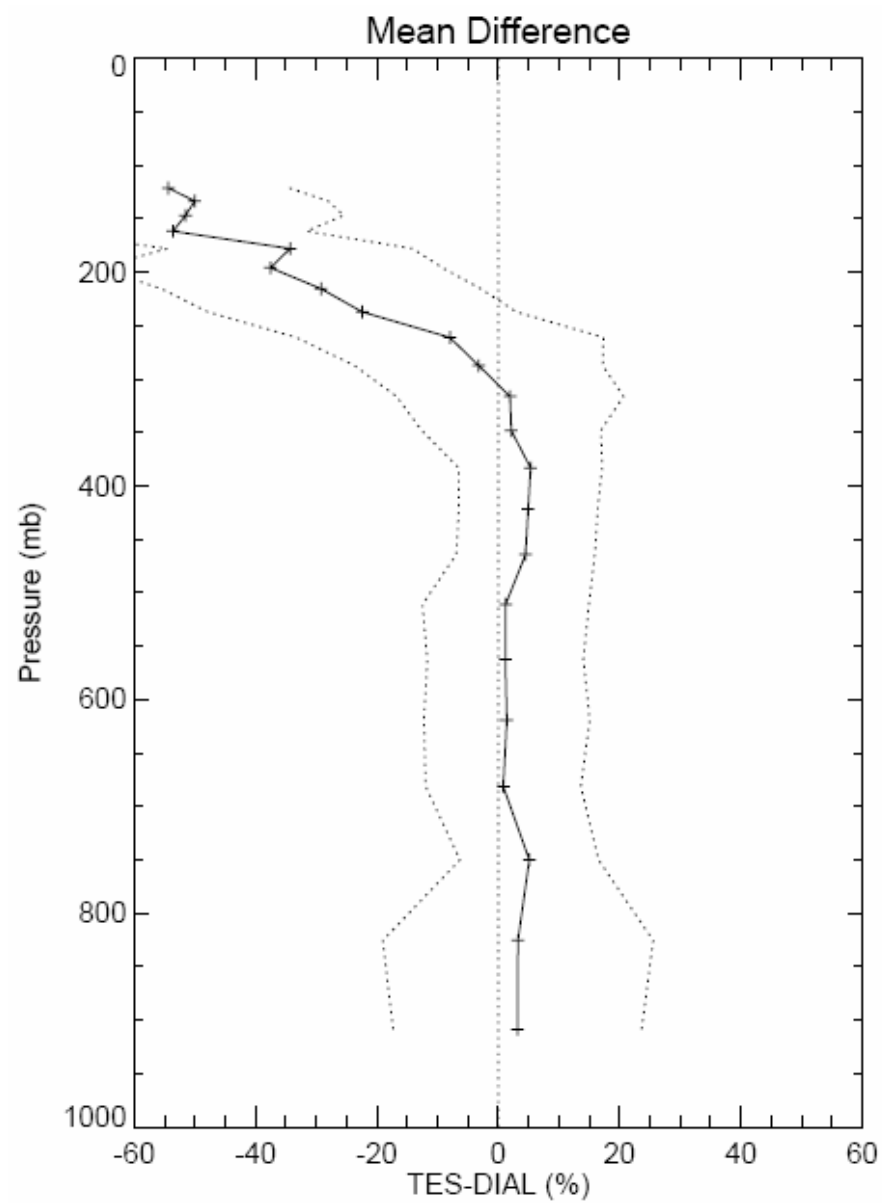
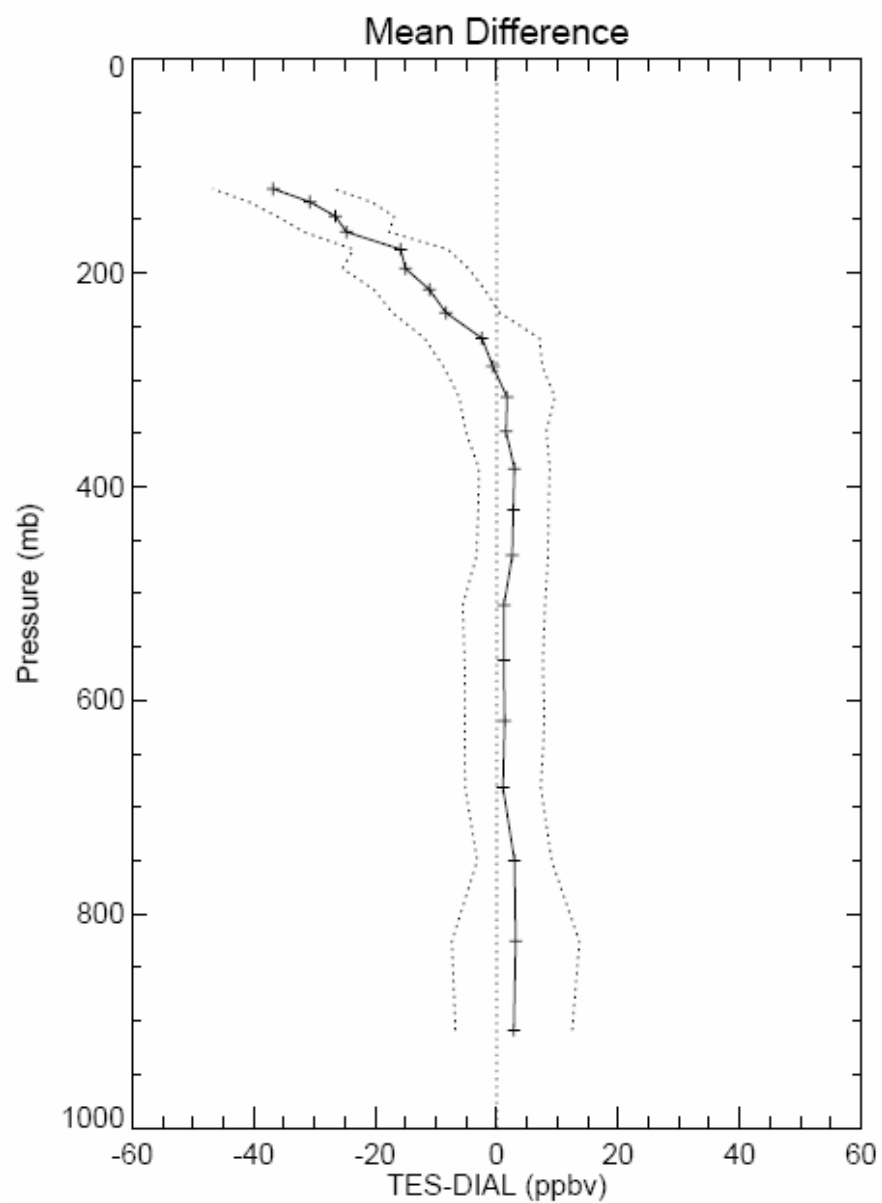
Aircraft flight track

## March 16<sup>th</sup> 2006 Run 3459



March 16<sup>th</sup> 2006 Run 3459

# TES – DIAL mean differences and standard deviation



# Conclusions

- Gaps in the profile make it difficult to apply the TES averaging kernels and make correct comparisons, but can be filled-in with TES *a priori* information.
- In general there is good agreement between TES and preliminary data from DIAL (within ~20%) with TES showing a small positive bias in the lower troposphere and a larger negative bias in the upper troposphere.
- The comparison on March 4<sup>th</sup> is more problematic due to the non-coincidence of the observations and may be the reason for some of the observed larger differences in the middle and upper troposphere.
- The density of profile information makes DIAL an excellent source of data for the validation of TES Ozone profiles.